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(54) **Article-handling apparatus for transferring articles between conveyors**

(57) An article-handing apparatus for a lehr loader or stacker transfers a series of articles (B) advancing in a first coordinate direction on a cross conveyor (14) across a dead plate (16) on to a lehr conveyor (12) in groups which form rows or ranks of articles for movement through an annealing lehr. The apparatus includes a pusher bar (22) which engages a group of articles on the cross conveyor and moves them across the dead plate between the two conveyors along a predefined path that imposes minimium changes in speed and direction to prevent damage or distortion to the articles. The path followed by each article is defined by one of a plurality of predetermined displacement programs stored in the memory of a programmable controller. The pusher bar (22) is supported on a system of carriages (30,32) that can be moved independently in the first coordinate direction and perpendicular thereto in the direction of advance of the lehr conveyor (12) and preferable also in a further perpendicular direction to raise or lower the bar.

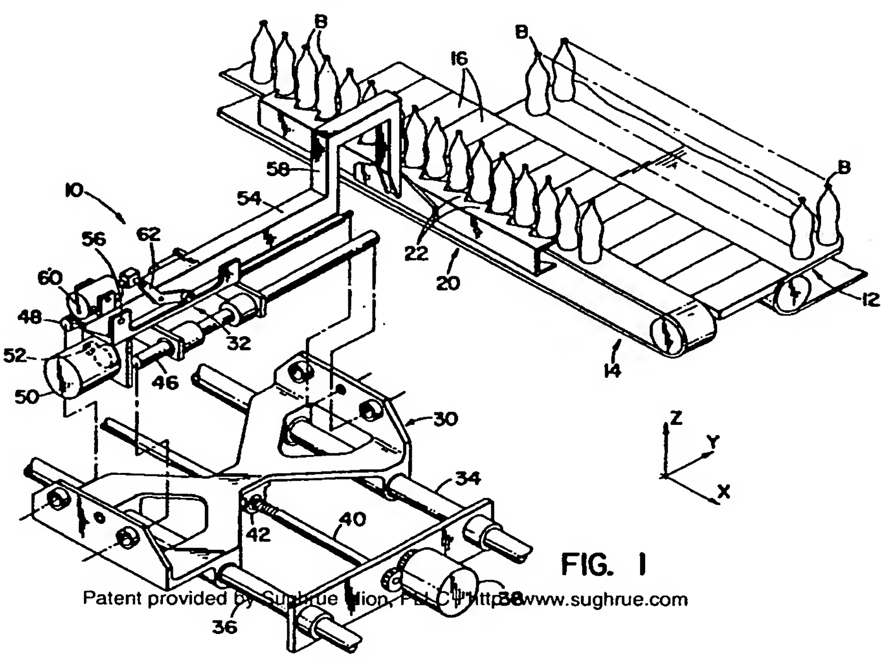

FIG. 1

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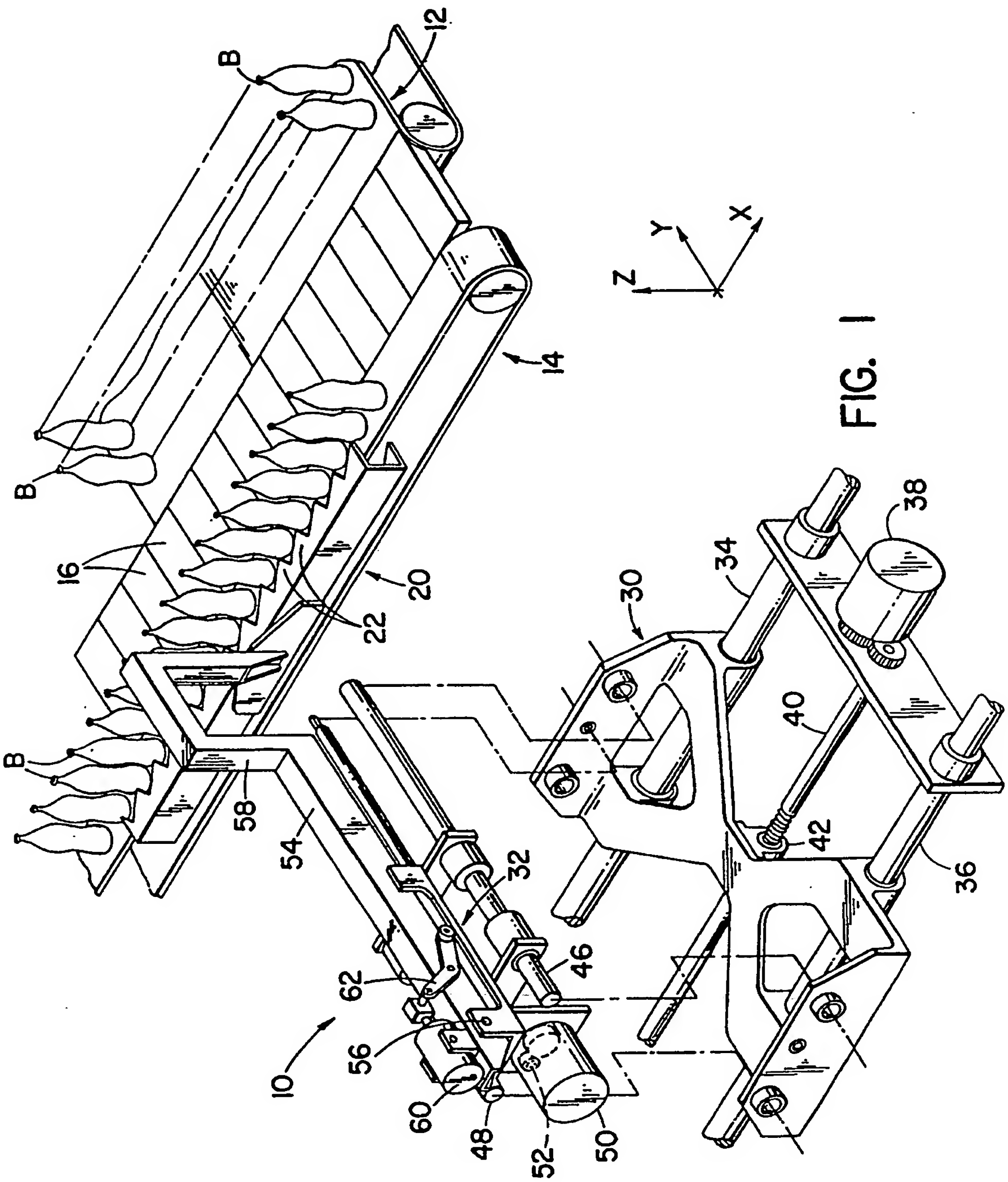
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12
B
14
16
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22
B
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54
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34
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56
10
60
48
52
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X
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FIG. 1

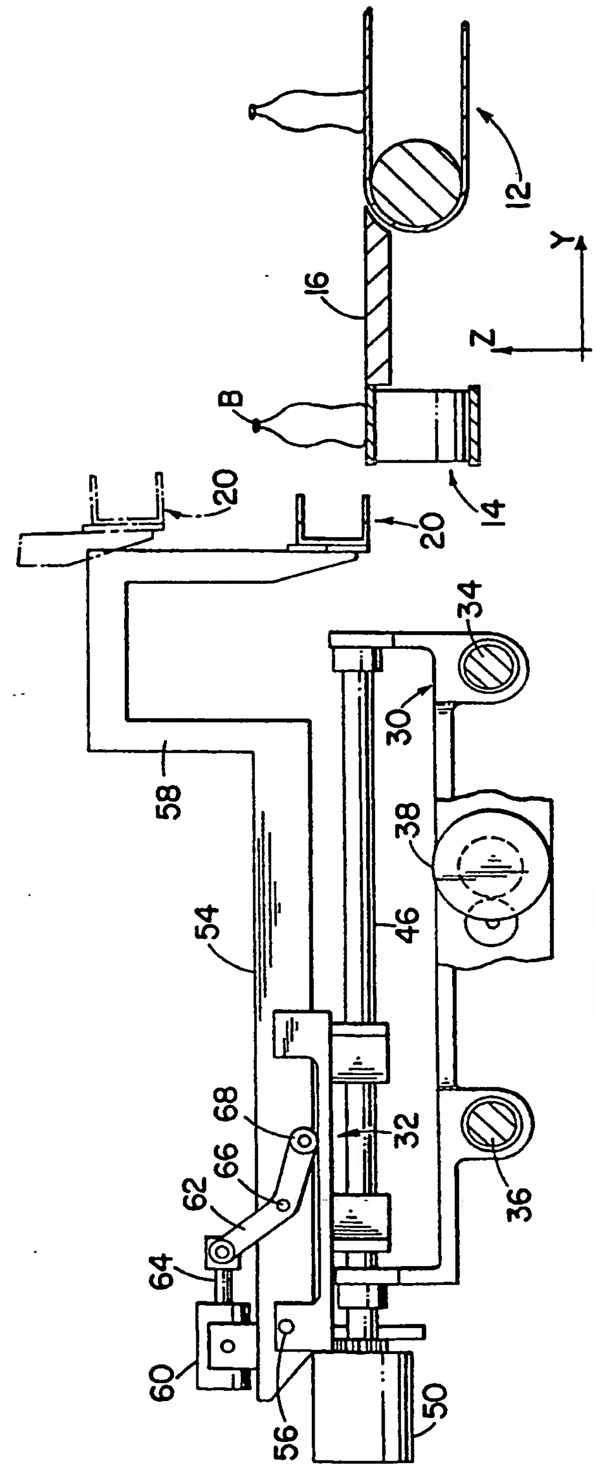

FIG. 2

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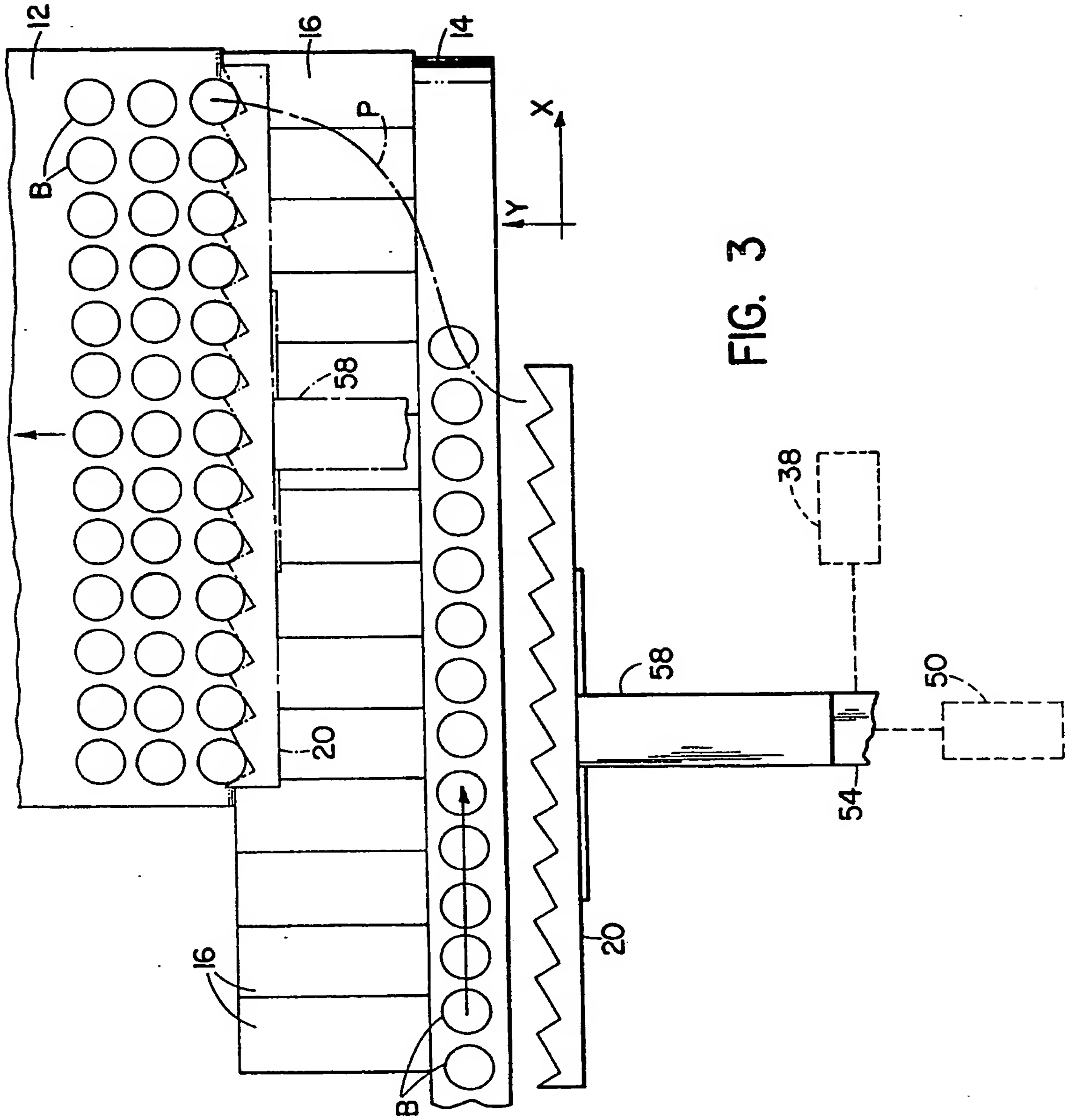

FIG. 3

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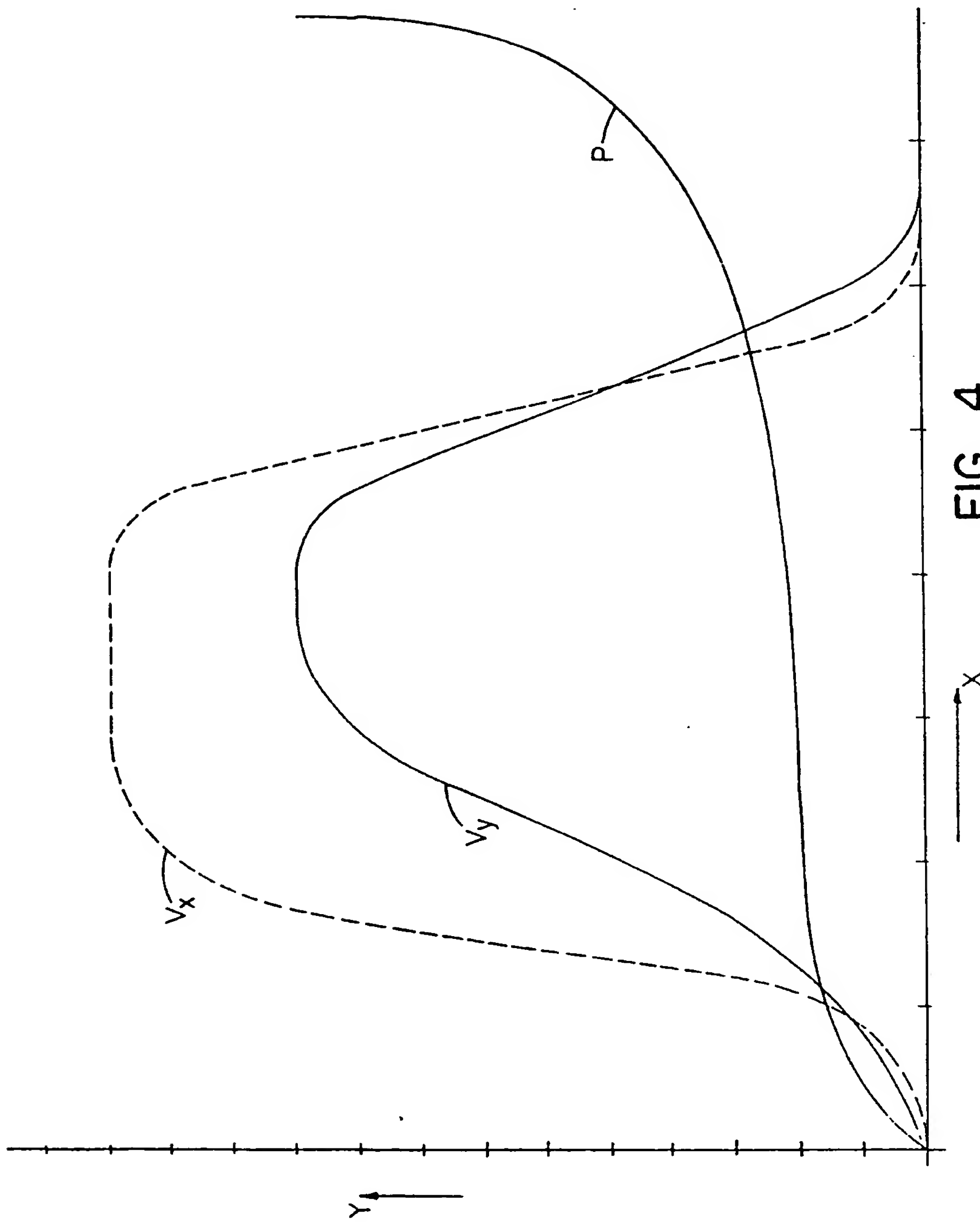
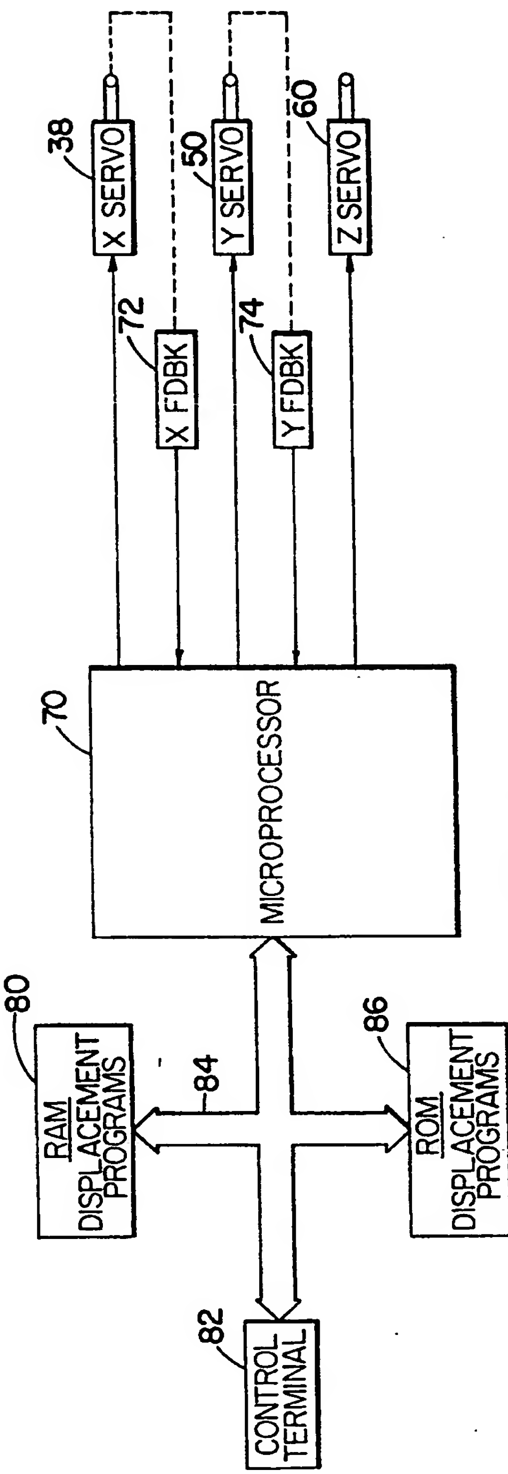


FIG. 4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50
Y SERVO
60
Z SERVO
72
X FDBK
74
Y FDBK
70
MICROPROCESSOR
80
RAM
DISPLACEMENT
PROGRAMS
84
86
ROM
DISPLACEMENT
PROGRAMS
82
CONTROL
TERMINAL

FIG. 5

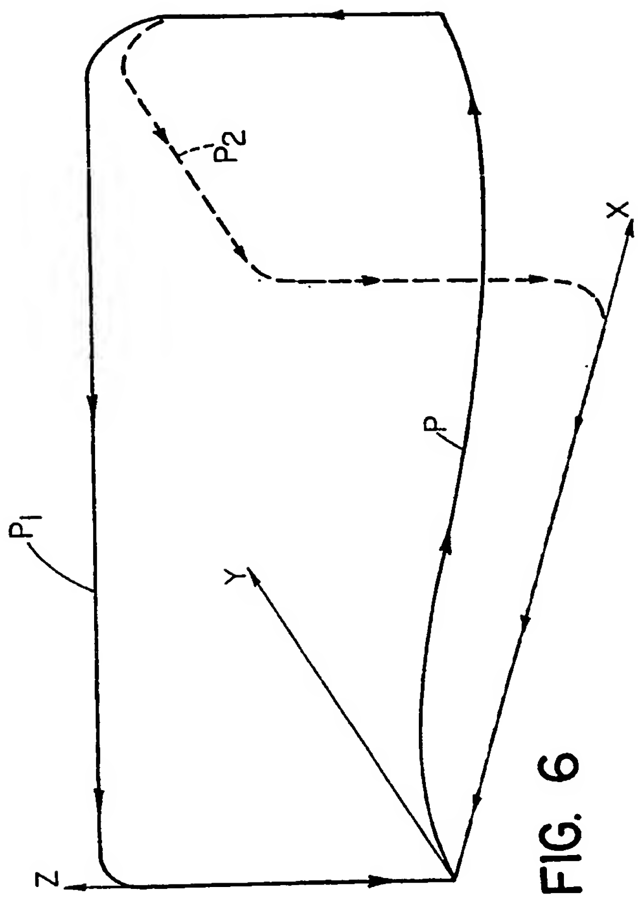


FIG. 6

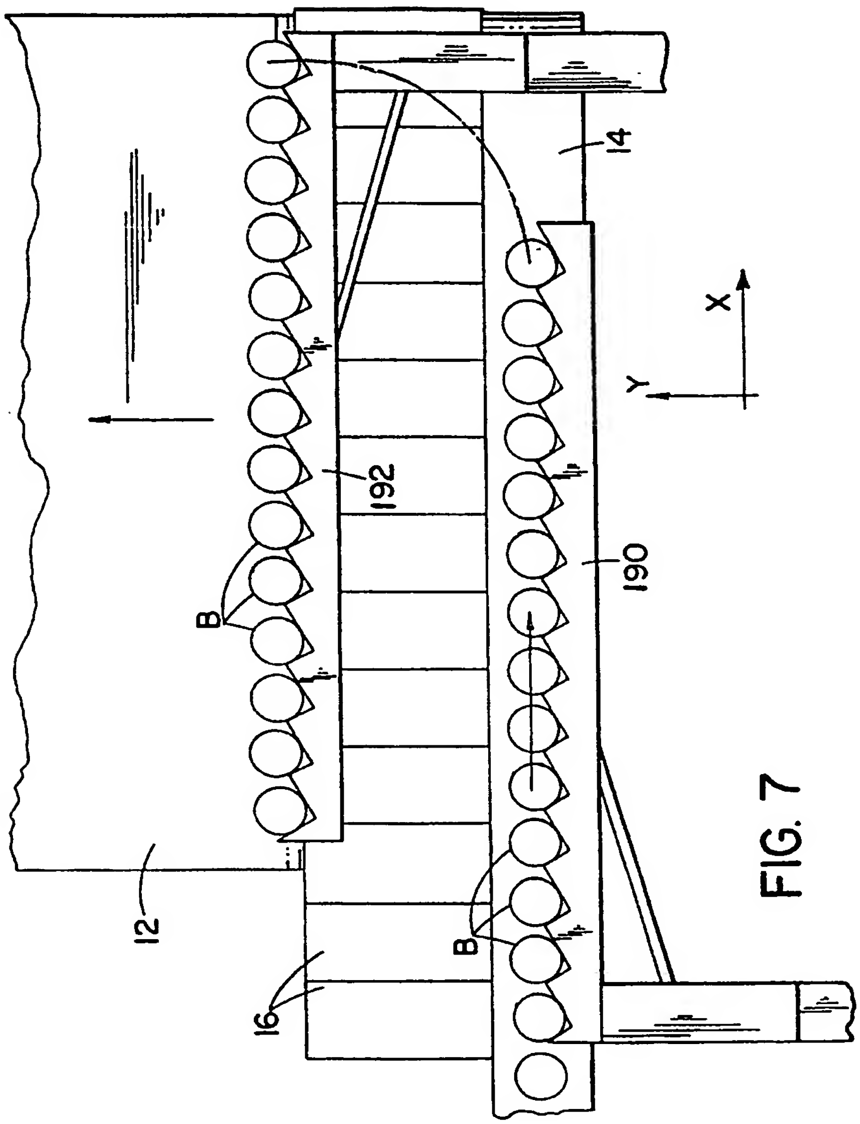
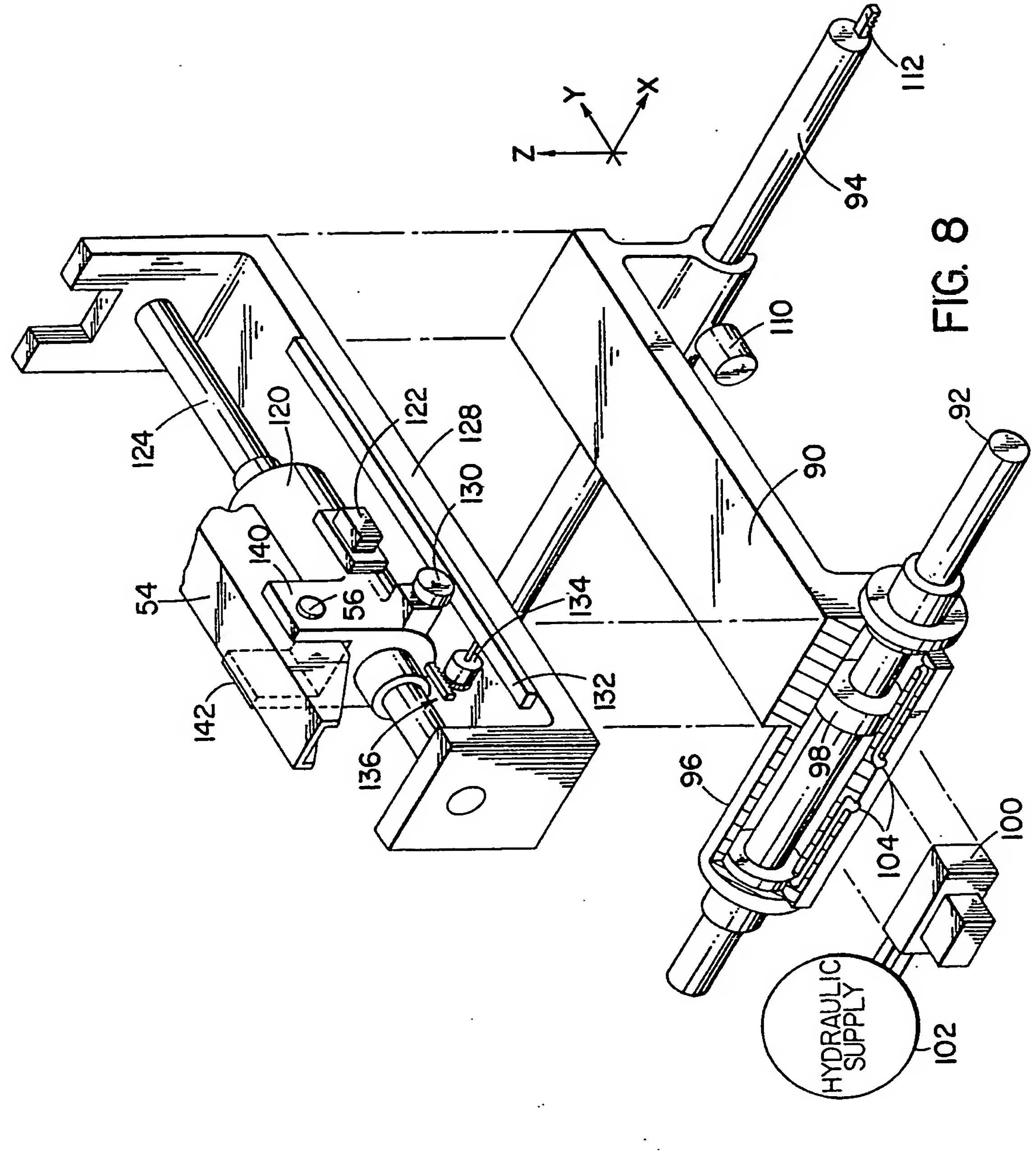


FIG. 7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Y
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90
124
120
122
128
130
54
140
56
134
132
142
136
96
98
104
100
HYDRAULIC SUPPLY
102

FIG. 8

SPECIFICATION

Article-handling apparatus for transferring articles between conveyors

The present invention relates to an article-handling apparatus commonly referred to as a lehr loader or stacker which transfers articles from a series on one conveyor to groups in rows or ranks on another conveyor. The apparatus is typically used in conjunction with an I.S. glassware machine for forming an array of glass articles that pass through an annealing lehr.

Lehr loaders or stackers are well known in the art. Typical loaders are shown in U.S. Patents 3 184 031; 3 687 262; 3 994 387; 4 003 464; and 4 067 434. While some of the stackers employ simple linkage mechanisms to operate the pusher bars and move the glassware between conveyors, in general more accurate control over the displacement paths of the ware is desired. For this reason, the stackers include cams and linkages that move the pusher bar with composite motions in at least two coordinate directions and establish a predetermined displacement path for the ware. The displacement paths must have velocity and displacement profiles or curves which produce changes in speed or direction that can be tolerated by the more fragile, newly formed ware prior to annealing in the lehr.

Frequently, it is necessary to change the displacement paths when, for example, the style, shape, size or weight of the ware is changed or when the frequency, spacing, or speed of the ware from the forming machine is varied. Under such circumstances, the cam driven stackers must be shut down, disassembled and reassembled while new cams are installed. Furthermore, since one cam defines only one displacement path for an article of glassware, a plurality of cams must be available or be on hand at all times for any change in the glassware-making process. The storage of a large number of cams is inconvenient, and the potential for losing one or more of the cams always exists.

Because of the difficulties and delays associated with the changing of cams during different glassware operations, cam operated loaders are not suited to fully automated glassware systems which are monitored and controlled by a computer. Ideally, data in the form of a job number should be inserted into the computer controls for the machine, and all adjustments in timing, temperature, and displacement should occur without assembling or disassembling the machine. With a cam operated lehr stacker, this is not possible.

It is accordingly a general object of the present invention to provide a lehr loader or stacker that can be controlled by a computer or microprocessor and in which the various displacement and timing parameters can be changed instantaneously, unlike a cam operated machine.

The present invention resides in a cyclically operated article-handling apparatus for transferring a series of articles, such as glassware, advancing in a first coordinate direction on a cross conveyor onto a lehr conveyor running in a second orthogonal coordinate direction. The apparatus transfers the articles in groups to form rows or ranks of articles for movement in the second coordinate direction through an annealing lehr. The cross conveyor is located at the loading end of the lehr conveyor in perpendicular relationship with the lehr conveyor, and a dead plate is disposed between the two conveyors to support the glassware during the transfer operation.

The apparatus includes a first carriage that moves back and forth in the first coordinate direction parallel to the movement of the cross conveyor, and a second carriage movable back and forth in the second coordinate direction parallel to the movement of the lehr conveyor. In the preferred embodiment, one carriage, such as the second carriage, is mounted on the other and the pusher bar is connected with the mounted carriage for movement in the two coordinate directions.

First servo-actuating means is connected in driving relationship with the first carriage and produces movement of the first carriage and the pusher bar relative to the conveyors in the first coordinate direction. Second servo-actuating means is connected in driving relationship with the second carriage and produces movement of the second carriage and pusher bar relative to the conveyors in the second coordinate direction. Together the two carriages and associated servo-actuating means produce composite movements that enable the pusher bar to move the glassware between the conveyors along predetermined two-dimensional displacement paths.

In order to establish the desired path, a programmable control means is connected in operative relationship with the first and second servo-actuating means and controls the movement of the two carriages. The programmable control means includes a data memory for storing displacement programs for the two carriages and the pusher bar. The programs define the displacements of the first and second carriages in the first and second coordinate directions respectively, and are executed in each cycle of the apparatus which moves a series of articles onto the loading end of the lehr conveyor from the cross conveyor.

By providing two carriages and corresponding servo-actuating means for independent movement in the two coordinate directions, the displacement of the pusher bar is not restrained by mechanical components, such as the cams utilized in the prior art, and the displacement profiles in each coordinate direction can be controlled independently to produce

any desired composite motion and displacement path between the cross conveyor and the lehr conveyor. Furthermore, changes in the displacement profiles can be made immediately through a control terminal, such as a keyboard or other data entry device, that is part of the programmable control means. A plurality of pre-established displacement programs can be held in a random access memory of the control means and individual programs can be selected as desired through coded entries or data keys, or new displacement programs can be entered and stored.

Preferred embodiments of the invention are described in detail hereinafter with reference to the accompanying drawings in which:

Figure 1 is a perspective view showing one embodiment of the novel article-handling apparatus serving as a stacker at the input end of a lehr conveyor.

Figure 2 is a horizontal elevation view of the stacker in Figure 1.

Figure 3 is a top plan view of the stacker in Figure 1 with the servo actuators shown schematically.

Figure 4 is a diagram illustrating typical displacement and velocity profiles produced by a displacement program in the programmable controller.

Figure 5 is a schematic diagram of the programmable controller having a microprocessor design.

Figure 6 is a three dimensional diagram illustrating the pusher bar displacements in a complete cycle of operation between the cross conveyor and the lehr conveyor.

Figure 7 is a plan view showing an alternate embodiment of the apparatus.

Figure 8 is a perspective view similar to Figure 1 and shows the stacker carriages in another embodiment of the novel article-handling apparatus.

Figure 1 illustrates one embodiment of the article-handling apparatus of the present invention in the form of a lehr loader or stacker, generally designated 10. The stacker 10 is located at the loading end of a lehr conveyor 12, and bottles B are fed into the stacker in series on a cross conveyor 14 from an IS forming machine. The bottles arrive in groups corresponding to the pattern and order in which the individual sections of the forming machine operate, and the stacker 10 transfers the bottles B in groups from the in-feed or cross-conveyor 14 over dead plates 16 onto the lehr conveyor 12 so that each transferred group of bottles forms a row or rank on the lehr conveyor. The bottles then pass en masse through the lehr (not shown) where they are heated and annealed.

A pusher bar 20 moves the bottles from the cross conveyor 14 to the lehr conveyor 12 by sliding the bottles off the conveyor 14 across the dead plates 16 onto the loading end of the lehr conveyor 12. The bar 20 operates in a cyclic manner and displaces the bottles along a path that results in a smooth transition from the bottle movement in the X-coordinate direction in the conveyor 14 to the movement in th Y-coordinate direction on the lehr conveyor 12. Speed and directional changes occurring during this course of movement are made as small as possible, taking into consideration the rate at which the bottles are formed, but are generally accomplished without any additional supporting devices other than profiled teeth 22 on the channel-shaped pusher bar 20.

In one cycle of operation beginning with the pusher bar 20 in the position adjacent the cross conveyor 14 as illustrated in Figures 1,2, and 3, the bar is moved along a displacement path P shown in Figures 3 and 4 by composite movement of the pusher bar in the X- and Y-coordinate directions. It will be understood that the displacement path P illustrates the movement of one of the bottles between the two conveyors and that each of the other bottles in the series follows a parallel path on to the lehr conveyor.

Preferably, as shown in Figure 4, the pusher bar initially moves toward the bottles on the cross conveyor at a relatively low velocity V_y in the Y-coordinate direction and also parallel with the bottles at a synchronous velocity V_x in the X-coordinate direction. Once contact is made with the bottles, the pusher bar accelerates very rapidly in the X-coordinate direction to a speed in excess of that of the cross conveyor 14 to shift the bottles laterally on the dead plates into alignment with the lehr conveyor, and after the bottles are on the lehr conveyor, the velocity Vx drops rapidly back to zero. The velocity Vy of the pushing bar toward the lehr conveyor increases at a more gradual rate as the bottles move across the dead plates 16 and reaches a peak near the middle of the dead plates. The velocity Vy drops off and finally reaches zero when the bottles rest on the loading end of the lehr conveyor 12.

To control the displacement and velocities of the pusher bar and bottles and to vary these kinematic parameters independently in each of the X- and Y-coordinate directions, the pusher bar 20 is mounted on an X-carriage 30 for movement in the X-coordinate direction and on a Y-carriage 32 for movement in the Y-coordinate direction. The X-carriage 30 is slidably mounted on a pair of guide bars 34, 36, and the carriage is moved back and forth by means of a servo actuator comprised by an electrical servomotor 38 with a ball lead screw 40 driven by the motor. The lead screw engages a recirculating ball nut 42 that is attached to the underside of the carriage 30.

The Y-carriage 32 is mounted directly on the X-carriage 30, but in Figure 1, the X-carriage and associated supporting and driving

structure are shown in a downwardly projected position for purposes of clarity. The Y-carriage 32 is slidably mounted on a pair of guide rods 46, 48 which are fixedly mounted to the X-carriage 30 and is moved back and forth in the Y-coordinate direction by means of a servo actuator comprised by an electrical servomotor 50 with a ball lead screw 52 driven by the motor. The ball lead screw connects to a recirculated ball nut (not shown) that is fastened to the underside of the carriage 32.

The pusher bar 20 is suspended from the forward end of a support arm 54, and the arm is pivotally connected to the rear end of the Y-carriage 32 by a pin 56. Thus, the pusher bar will move in the X- and Y-coordinate directions with the X- and Y-carriages 32, 34 respectively and can be elevated and lowered in the Z-coordinate direction relative to the conveyors 12, 14 and bottles B by the pivoting movement of the support are 54. Such movement is necessary during the return motion of the pusher bar from the lehr conveyor to the cross conveyor since the cross conveyor 14 generally moves continuously and brings the next series of bottles B to be transferred into position behind the pusher bar through the U-shaped bracket 58 at the projecting end of the support arm 54.

The pusher bar 20 is elevated in the Z-coordinate direction by means of a servo actuator that is comprised by the drive motor 60 and the actuating link 62. As shown in Figure 2, the drive motor 60 has a linearly moved output shaft 64 which is pivotally mounted to the rear end of the support arm 54. Since the velocity profile in the Z-coordinate direction is not critical, the drive motor 60 may be a pneumatic actuator having a fixed displacement piston pivotally connected to the upper end of the actuating link 62. The link 62 is pivotally connected at axis 66 to the support arm 54, and at the lower end is provided with rollers or bearings 68 which contact and travel on the Y-carriage 32 when the link 62 is rotated about the pivot axis 66 by the pneumatic actuator. As the link 62 rotates clockwise from the position illustrated in Figure 2, the support arm 54 and pusher bar 20 are elevated to the phantom position such that the bar clears any of the bottles B on the cross conveyor 14 behind the bar. When the bar 20 returns to a position on the opposite side of the cross conveyor from the lehr conveyor 12, the actuator 60 is de-energized and the arm 54 is lowered onto the Y-carriage 32 in the position illustrated with the pusher bar 20 in the solid line position.

Figure 5 illustrates the programmable controller that is connected in operative relationship with the servo actuators that produce pusher bar movement along the coordinate axes. The controller is a microprocessor-based design in the preferred embodiment and includes a microprocessor 70 that produces the control signals for each of the servo actuators 38, 50, and 60. The control channels for the X- and Y-coordinate axes are closed loop and hence a position feedback transducer 72 is connected the the X-servo actuator 38 and another position feedback transducer 74 is connected with Y-servo actuator 50. The feedback transducers provide position and velocity information to cause the X- and Y-carriages to precisely track the profiles defined by displacement programs in the programmable controller.

A random access memory 80 forming part of the microprocessor or supplementing the processor memory stores predetermined displacement programs or displacement programs which are defined and loaded in the memory by the control terminal 82 through the data bus 84. Typically, the control terminal would be a key-board, a tape reader or punch card reader, a data key reader or possibly another computer in which the velocity profiles are generated, either interactively or automatically. Alternatively, or in addition to the memory 80, an additional read-only memory 86 can be connected with the data bus 84 to store additional programs that are utilized on a recurring basis. Hence the memory 86 must be nonvolatile and typically would be composed of EP-ROM's.

The machine operator or, in the event of a fully automated system, another computer, calls up a particular displacement program that defines a desired path of movement for the pusher bar 20 and the bottles B between the cross conveyor 14 and the lehr conveyor 12. That program is then loaded into a temporary memory within the processor 70, and with additional timing signals received from the glassware machine, the microprocessor controls the pusher bar 20 to load the lehr conveyor in a cyclic operation.

If, after a particular run, a new bottle or a different sequence of operations distributes the bottles in a new manner on the cross conveyor, another displacement program can be readily called up through the control terminal 82, and the glass-making process can continue virtually uninterrupted and without changing cams and restructuring the machine.

Furthermore, the displacement programs can be clipped or started at different locations along the programmed displacement through simple data manipulation. Accordingly, the independently controlled carriages which support the pusher bar 20 permit an infinite variety of displacement programs to be employed, and changes in the programs can be made by the machine operator through a simple data entry.

While the present invention has been described above in one preferred embodiment, it should be understood that numerous modifications and substitutions can be had without departing from the spirit of the invention. For

example, the servo actuators shown in Figures 1 and 2 are described as electrical servomotors which generally include the feedback transducers illustrated in Figure 5. However, other types of servo actuators, including pneumatic and hydraulic motors, can be employed for moving the X and Y carriages on which the pusher bar 20 is supported.

In this regard, Figure 8 illustrates an embodiment in which the X-carriage 90 is slidably mounted on a pair of stationary support rods 92,94 and is moved by means of a hydraulic actuator comprised of a cylinder 96, a piston 98, and a hydraulic servovalve 100. The valve controls the flow of hydraulic fluid between a hydraulic supply 102 and the control ports 104 on the cylinder. The valve 100 is shown in an exploded position in order to illustrate the ports, and would otherwise be secured to the side of the cylinder in overlying relationship with the ports.

The piston 98 is secured or otherwise attached fixedly to the support rod 92 so that hydraulic fluid pressure developed in either end of the cylinder causes the cylinder and the X-carriage 90 to move together along the rods 92,94 in the illustrated X direction.

A rotary position feedback transducer 110 mounted on the X-carriage 90 engages a gear rack 112 secured to the bottom side if the guide rod 94, and as the carriage moves back and forth, the transducer produces a feedback signal for accurate control of carriage position.

The Y-carriage 120 is comprised primarily by the cylinder of another hydraulic actuator having a servovalve 122 and a piston (not shown) mounted fixedly on a piston rod 124 within the cylinder. Like the valve 100, the valve 122 is connected to the hydraulic supply 102 and controls the flow of hydraulic fluid into the cylinder to cause the cylinder and attached structure to move back and forth on the piston rod 124 in the Y-coordinate direction.

The Y-carriage 120 and associated structure is mounted on the X-carriage 90 by means of a connecting frame member 128. The frame member is fixedly attached to the top of the X-carriage 90 as indicated, and the piston rod 124 is fixedly attached to the frame member.

To stabilize the Y-carriage or cylinder 120 within the frame member 128, a pair of rollers 130 (only one visible) are secured on opposite sides of the cylinder. The rollers rest on top of a corresponding pair of guide ways 132 (only one visible) which are also secured to the frame member 128. The guide ways 132 additionally serve as ways for the lifting link 62 in Figures 1 and 2 for lifting the pusher bar up and down in the Z-coordinate direction.

A rotary position feedback transducer 134 is secured to the frame member 128 below the Y-carriage 120, and is engaged by a gear rack 136 fixed to the lower side of the carriage. Thus, movement of the carriage in the Y-coordinate direction produces a feedback signal in essentially the same fashion as the feedback transducer 110 secured to the X-carriage.

The carriage 120 has two lugs 140,142 at its rear, upper side. The support arm 54 from which the pusher bar (not shown) is mounted in cantilever fashion is pivotally mounted between the lugs on the pin 56 in the same manner as in Figures 1 and 2. The servo actuator 60 that pivots the support arm 54 on the pin 56 and simultaneously moves the pusher bar up and down in the Z-coordinate direction is not shown for clarity, but mounts above the support arm and operates the support arm in conjunction with the link 62 as described previously. If desired, the servo actuator 60 may be a hydraulic actuator connected with the hydraulic supply 102 through a four-way solenoid valve. The solenoid valve and the two servovalves 100 and 122 can be controlled by the microprocessor 70 to move the pusher bar 20 in the same manner as described above in connection with Figure 5.

Although the invention has been described above in the context of a single pusher bar and associated carriages, it is also applicable to compound systems such as shown in Figure 7 wherein two separate pusher bars perform the transferring operations alternately with a reduced duty cycle on each bar. In other words, the pusher bar 190 moves half of the incoming bottles B between the cross feed conveyor 14 and the lehr conveyor 12 every other cycle of operation while the pusher bar 192 transfers the other half of the bottles between the conveyors during the intervening cycles. In such case, each pusher bar is supported independently by its own X- and Y-carriages and each set of carriages is controlled separately by the microprocessor.

The pusher bars 190,192 utilize the same displacement profile or path P between conveyor 14 and conveyor 12, as shown in Figure 6, but operate in an 180°-phase relationship so that each bar transfers bottles at different points in time. The return paths for the bars, however, are preferably different to avoid interference. For example, the bar 190 utilizes a return path Pl in Figure 6, such that which would be used by the bar 20 in Figures 1-3, while the bar 192 utilizes the dotted return path P2.

Accordingly, the present invention has been described in several preferred embodiments by way of illustration rather than limitation.

CLAIMS

1. A cyclically operated article-handling apparatus for transferring a series of articles advancing in a first coordinate direction (X) on a first conveyor onto a second conveyor in groups to form rows or ranks of articles for movement in a second orthogonal coordinate direction (Y), the first conveyor being located

in perpendicular relationship with the second conveyor at the loading end of the second conveyor and a dead plate being disposed in between the two conveyors, comprising

a first carriage movable back and forth in the first coordinate direction parallel to the movement of the first conveyor;

a second carriage movable back and forth in the second coordinate direction parallel to the movement of the second conveyor;

an article-engaging pusher bar supported by the first and second carriages above the first conveyor, the dead plate, and the second conveyor for engagement with the articles and movement of the articles between the two conveyors in the first and second coordinate directions;

first servoactuating means connected in driving relationship with the first carriage and producing movement of the first carriage and the pusher bar relative to the conveyors in the first coordinate direction;

second servoactuating means connected in driving relationship with the second carriage and producing movement of the second carriage and pusher bar relative to the conveyors in the second coordinate direction; and

programmable control means connected in operative relationship with the first and second servoactuating means for controlling movement of the first and second carriages and including a data memory for storing displacement programs defining predetermined movement of the first and second carriages and the pusher bar in the first and second coordinate directions.

2. An article-handling apparatus for transferring articles on a first conveyor onto a second conveyor as defined in claim 1 further comprising:

a third carriage supporting the pusher bar for movement up and down in a third coordinate direction relative to the conveyors and the articles; and

third servoactuating means being connected in driving relationship with the third carriage and in operative relationship with the programmable control means for independently controlling movement of the third carriage,

the data memory storing displacement programs also defining predetermined movement of the third carriage and pusher bar in the third coordinate direction.

3. An article-handling apparatus for transferring a series of articles on a first conveyor onto a second conveyor as defined in claim 1 wherein the data memory of the programmable control means includes a plurality of predetermined displacement programs, and the programmable control means additionally includes means for selecting specific displacement programs from the data memory for controlling the movement of the first and second carriages by the first and second servoactuating means.

4. An article-handling apparatus for transferring a series of articles on a first conveyor onto a second conveyor as defined in claim 2 wherein the data memory of the programmable control means includes a plurality of predetermined displacement programs, and the programmable control means additionally includes means for selecting specific displacement programs from the data memory for controlling the movement of the first, second and third carriages by the first, second, and third servoactuating means.

5. An article handling apparatus for transferring a series of articles on a first conveyor onto a second conveyor as defined in claim 1 wherein

each displacement program in the data memory contains data defining coordinated displacements of the first and second carriages between the first conveyor and the second conveyor.

6. An article handling apparatus for transferring a series of articles on a first conveyor onto a second conveyor as defined in claim 4 wherein

each displacement program in the data memory contains data defining coordinated displacements of the first, second, and third carriages back and forth between the first conveyor and the second conveyor.

7. An article-handling apparatus for transferring a series of articles on a first conveyor onto a second conveyor as defined in claim 1 wherein

one of the first and second carriages is mounted on and movable relative to the other of the carriages, and the servoactuating means associated with said one of the first and second carriages is also mounted on the other of the carriages; and

the pusher bar is mounted on said one of the first and second carriages for movement with the carriages in each coordinate direction respectively.

8. An article-handling apparatus for transferring a series of articles on a first conveyor to a second conveyor as defined in claims 1 wherein

the memory of the programmable control means contains a plurality of displacement programs defining composite movements of the first and second carriages in the first and second coordinate directions; and

the programmable control means further includes means for selecting a predetermined one of the plurality of displacement programs for controlling movement of the first and second carriages and the pusher bar by the servoactuating means.

9. A lehr loader for cyclically transferring groups of articles moving in a series on a cross conveyor onto a lehr conveyor arranged transversely of the cross conveyor, the groups of the articles transferred being arranged on the lehr conveyor in rows or ranks generally

parallel to the series of articles on the cross conveyor for movement through a lehr, comprising:

a first carriage movable back and forth in a first coordinate direction parallel to the movement of the articles on the cross conveyor;

first servo actuator means connected in controlling relationship with the first carriage for controlling carriage movement in the first coordinate direction;

a second carriage movable back and forth in a second coordinate direction parallel to the movement of the rows of articles on the lehr conveyor;

second servo actuator means connected in controlling relationship with the second carriage for controlling carriage movement in the second coordinate direction;

a pusher bar supported from the first and second carriages over the cross conveyor and the lehr conveyor for movement back and forth between the conveyors in the first and second coordinate directions, the bar being in a position generally parallel to the series of articles on the cross conveyor and the rows of articles on the lehr conveyor and engaging the articles in pushing relationship during bar movement from the cross conveyor to the lehr conveyor,

programmable control means connected with the first and second servo actuator means for controlling the movement of the pusher bar between the conveyors by the servo actuator means, the control means including a control terminal for entering data and a data memory for storing displacement programs defining coordinated movements of the pusher bar and engaged articles in the two coordinate directions along a predetermined path between the conveyors whereby the programmable controller can be programmed through the control terminal to move the articles between the conveyors along a preselected path defined by a stored displacement program.

10. A lehr loader for cyclically transferring groups of articles as defined in claim 9 wherein:

the data memory has a memory capacity for storing a plurality of displacement programs defining a plurality of predetermined paths of movement between the conveyors; and

the control terminal connects with the data memory to select the displacement programs individually for controlling the pusher bar and article movement between the conveyors.

11. A lehr loader for cyclically transferring groups of articles as defined in claim 9 wherein the first and second servo actuator means comprise electrical servo motors.

12. A lehr loader for cyclically transferring groups of articles as defined in claim 9 wherein the first and second servo actuator means comprise hydraulic actuators.

13. A cyclically operated article-handling apparatus substantially as hereinbefore described with reference to and as shown in Figures 1,2,3 and 5 of the accompanying drawings.

14. A cyclically operated article-handling apparatus substantially as hereinbefore described with reference to and as shown in Figure 7 of the accompanying drawings.

15. A cyclically operated article-handling apparatus substantially as hereinbefore described with reference to and as shown in Figure 8 of the accompanying drawings.

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